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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
TAYLOR, VICTOR J	

ART UNIT	PAPER NUMBER
2863	

DATE MAILED: 06/02/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/690,481	FAVRET ET AL.	
	Examiner	Art Unit	
	Victor J. Taylor	2863	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 October 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 October 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 6.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☒ Other: *First Office Action*.

DETAILED ACTION

Drawings

1. The drawings were received on October 20, 2003. These drawings are approved.

Prior Art

2. The prior art made of record and not relied upon is considered pertinent to applicant:

I. Nickel in US 6,640,190 in class 702/014 is cited for the method for 3-D depth migration steps for estimating subsurface geophysical data with methods to process first data sets and second data sets of digital subvolume data in figure 1 using subvolume data taken from the volume data set 1102 in figure 11 along the Z trace direction in lines 5-60 of column 6.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) The invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1-26 are rejected under 35 U.S.C. 102(b) as being anticipated by Alam in US Patent 6,278,949.

With regard to claim 1, Alam discloses all the limitations for claim 1 and further discloses the Seismic data processing in figure 1. He further discloses the steps for selecting the small subvolume as the "small subvolume of time-windowed traces, with each trace containing multiple events, that is circumscribed around each event as the center of a scalar mathematical functional. The "Event Dissimilarity" is derived to measure the dissimilarity by combining the temporal attribute differences between the center event and each event on the laterally separated traces within the said "subvolume."" See the seismic data input batch in figure 1 and the volume and subvolume in lines 35-44 of column 5.

He further discloses and teaches, "The event with the least Event Dissimilarity on a trace is called the `most similar event` for that trace. He teaches a smooth approximating surface, and the local wave front, estimated such that it passes exactly through the time at the center event and best fits the times of most similar events on laterally separated traces. The time misfit error statistics, including the mean and variance of time residuals between the actual event time and local wave front time at each trace in the said subvolume is calculated. A `local attribute surface` is estimated for each attribute in a manner similar to the estimation of local wave front. Each local attribute surface passes exactly through the value of that attribute at the center event and best fits the

value of the same attribute at each event whose time is in closest proximity to the local wave front in figure 1 and in column 5 all lines.

A misfit error is then calculated for each attribute. Parameters of the local wave front, time misfit error, each local attribute surface and corresponding attribute misfit error are collectively called spatial attributes." Of the target set from the seismic geophysical data batch as found in figure 1 and in lines 35-65 of column 5. He further discloses the superset of N attributes, i.e. [the known features of interest], and the combining of both the temporal and spatial attributes, that characterizes the volume of waveform in the neighborhood of the center event. The procedure maps a 3-dimensional event at (x, y, t) into an N-dimensional attribute space", as found in lines 60-65 in column 5.

Alam further discloses the plurality of positions associated with the plurality of points into the N-dimensional point in the attribute space i. e. "the known volume" in the volume in lines 60-65 of column 5. He further teaches the "attribute gradient is the spatial gradient of the surface that passes through an attribute at center event and best fits the same attribute of events that are in close proximity of the local wave front on laterally separated traces within a small subvolume of the total volume, i. e. "the subcube within the cube or parallelepiped structure" and enclosing the center event in lines 60-66 of column 7. He further discloses the "normalized attribute gradient vector is a normalized set of attribute gradients corresponding to a specified set of attributes and teaches a superset comprising the union of normalized temporal and spatial attributes, and normalized time gradient to local wave front, using equations

[A.sub.I, . . . , A.sub.N], and further teaches that the subset is associated with the event, (x, y, t), so that a 3-dimensional point or position in the seismic volume is mapped into an N-dimensional point in the attribute space as found in lines 1-15 of column 8.

He further teaches the model in the workstation using 10 principal steps. First, the model of a seismic volume as a collection of events in a 3-dimensional (x, y, t) space, called domain D. In the case of a regularly sampled 3-D data, these events are indexed equally in the x- and y-directions, although the space interval between indices may be different for each direction. Event sampling in the time t-direction is generally sparse and unequally spaced. Second, associate with each event a number, N, of attributes, denoted by the vector A. Third, normalize each attribute in the [0,1] interval. This process maps said 3-dimensional domain to an N-dimensional L1-normed attribute range. The absolute value attribute norm, L1, is used for computational efficiency, but does not limit the application of the method, which is valid for any norm. Fourth, if depth instead of time is used to analyze the spatial continuity of an event, said (x, y, t) space is scaled by an appropriate velocity to represent actual distances in the three directions. This space is L2-normalized and labeled as a new (x, y, z) coordinate system with Euclidean norm. The continuity of an event is then quantitatively analyzed in terms of Frechet derivatives, taught by D. G. Luenberger, p. 172-500" taught in lines 15-35 in combinations with figure 1. He further teaches the fifth interactively threshold and combines any subset of attributes via a spatial, arithmetic, logical or morphological operation into an

indicator functional, which is again normalized to [0,1] interval. Sixth, steps for mapping the normalized interval to a user selected color spectrum on a graphical workstation. Seventh, the rendering of events as points in the 3-D survey volume, and assign to each point the color that represents the indicator functional value of the event, as for example the average of normalized amplitude and normalized peak-to-trough amplitude difference. The three dimensional display shows geological structures as loci of events, and stratigraphic compartments as patterns of colors. Eighth, steps to remove unwanted regions in the volume by the use of a histogram filter. Ninth, steps to select a thin slab whose face is parallel to one of the three principal planes and integrate the indicator functional over the thickness of the slab. Animate the slab in a direction perpendicular to the face of the slab with target anomalies moving into and then out of the viewing range. Apply a similar animation process to the rotation of either the entire volume or a small sub volume, wherein the integration is performed along arcs in a small angular wedge through the axis of rotation. Tenth, steps to locate with a graphical cursor any isolated anomaly and output the result as a hardcopy plot or archival file in lines 35-60 of column 8.

Re claim 2, which stands rejected on the rejected base claim, the steps for performing the limitation of displaying the results as displayed in the graphical work station are disclosed in figure 1 and further disclosed steps in which any "subset of individually normalized attributes is then selected and combined on a graphical workstation into a functional, called indicator functional, with its range

of values mapped in a color spectrum. The resulting 3-D display automatically shows geological structures as locus of point sets and the stratigraphic compartments as color variations within the point and position sets within the volume. The same color in spatially separated anomalies indicates that the anomalies share common features characterized by the threshold range and the mix of individual attributes in the indicator functional. Furthermore, on a workstation equipped with sound, the two or more subsets of N attributes instead of one are combined into indicator functional with functional values of one displayed in color and those of others played as sounds of varying audio-frequency tone and volume." as disclosed in lines 1-15 of column 6.

Re claims 3-5 which stand rejected on the rejected base claim, Alam discloses in FIG. 4 a detailed plot of the single signal trace, h (t), at grid node, 31. The process "calculates from the trace and its Hilbert Transform the instantaneous envelope 42, e (t), instantaneous phase, .phi.(t), and instantaneous frequency, .omega.(t). The troughs of the envelope function e (t) are used to define boundaries of the wave packet, identified by the index i, 43. The trough boundaries also coincide with locations where the instantaneous frequency has spikes and the instantaneous phase has discontinuities." After detecting each wave packet boundary "sub boundaries" on a trace the process cuts the trace into contiguous wave packets which begin at one and end at the next boundary. The index i, 43, varies over the plurality of wave packet segments that make up the signal trace, h(t), at grid location 31. "For brevity, the qualifying word `instantaneous` will be dropped henceforth and references to the envelope,

frequency, and phase functions will imply that they are instantaneous functions" disclosed in lines 10-24 column 9.

Alam further teaches and discloses in the prior art a method of obtaining a set of discontinuity attribute traces distributed over a 3-D volume of the earth. The 3-D volume of input seismic traces is divided into a plurality of vertically stacked and spaced apart horizontal slices. Each slice is divided into a plurality of sub volume cells having at least three seismic traces located therein. The maximum time lagged cross-correlation is measured between the first and second traces lying in a vertical plane to obtain an in-line value and another maximum time lagged cross-correlation between the first and third traces lying in the orthogonal vertical plane to obtain a cross-line value. The geometric mean of the in-line and cross-line values is termed `coherency` associated with the time at the center of the first trace window. Coherency is normalized to lie in the [0,1] interval. The discontinuity attribute is equal to (1-Coherency). This attribute is displayed instead of the seismic time slice on a conventional interpretation workstation. The method works well in areas of gentle dips and low noise, but because it requires an ambient dip and azimuth information it gives false results in areas of steep dips and high noise" in lines 40-60 of column 3.

Re claims 6 and 7 which stand rejected on the rejected base claims, the limitation further comprising the steps for transforming the data sets by performing a Hilbert transform identified by surface location (x, y), in a fixed length sequence of waveform amplitude samples digitized at equal time (or depth) increments with the wave packet the portion of a waveform contained

between consecutive minima of the instantaneous envelope function derived from the trace and its Hilbert Transform and coincide with discontinuities in the instantaneous phase trend or spikes in the instantaneous frequency function. An event, identified by (x, y, t), is the time of a specified amplitude feature or the time of a specified phase of the waveform, which may be the input trace or its mathematical transform such as instantaneous envelope function. The specified feature may be a maximum, minimum, zero crossing on the rise or fall, or any other identifiable feature of the waveform in lines 25-40 of column 7.

And further comprising the steps for calculating cross correlation from data distributed in the N-dimensional in the s associated with the event, (x, y, t), so that a 3-dimensional point in the seismic volume is mapped into an N-dimensional point in the attribute space. This invention comprises 10 principal steps. First, model a seismic volume as a collection of events in a 3-dimensional (x, y, t) space, called domain D. In the case of a regularly sampled 3-D data, these events are indexed equally in the x- and y-directions, although the space interval between indices may be different for each direction. Event sampling in the time t-direction is generally sparse and unequally spaced. Second, associate with each event a number, N, of attributes, denoted by the vector A. Third, normalize each attribute in the [0,1] interval. This process maps said 3-dimensional domain to an N-dimensional L1-normed attribute range. The absolute value attribute norm, L1, is used for computational efficiency, but does not limit the application of the method, which is valid for any norm. Fourth, if depth instead of time is used to analyze spatial continuity of an event, said (x, y,

t) space is scaled by an appropriate velocity to represent actual distances in the three directions. This space is L2-normalized and labeled as a new (x, y, z) coordinate system with Euclidean norm. The continuity of an event is then quantitatively analyzed in terms of Frechet derivatives, taught by D. G. Luenberger, p. 172-5 found in lines 15-40 of column 8.

Re claims 8-9 which stand rejected on the rejected base claims, Alam further teaches selecting the image set from real seismic data in figure 1 and teaches steps for calculating the cross correlation in figure 1 using the workstation and a detailed plot of the single signal trace, h (t), at grid node, 31. The process calculates from the trace and its Hilbert Transform the instantaneous envelope 42, e (t), instantaneous phase, .phi.(t), and instantaneous frequency, .omega.(t). The troughs of the envelope function e (t) are used to define boundaries of the wave packet, identified by the index i, 43. The trough boundaries also coincide with locations where the instantaneous frequency has spikes and instantaneous phase has discontinuities. After detecting each wave packet boundary on a trace the process cuts the trace into contiguous wave packets, which begin at one and end at the next boundary. The index i, 43, varies over the plurality of wave packet segments that make up the signal trace, h(t), at grid location 31. For brevity, the qualifying word `instantaneous` will be dropped henceforth and references to the envelope, frequency, and phase functions will imply that they are instantaneous functions in lines 10-25 of column 9.

Re claims 10-11 which stand rejected on the rejected base claims, Alam further teaches selecting the Amplitude difference between the peak, 52, and the following trough: A.sub.6 (x,y,i,j)=h(p)-h(s) and the Wave Packet Attributes and the Attributes in vector elements, A7, . . . , A10, as identified in figures 4 and 6 in lines 25-30 of column 10.

Re claims 12-15 which stands rejected on the rejected base claims, Alam further teaches selecting the seismic image data and data cube with data cube subsets in figure 1 using the workstation and in the attribute subset identified by: k=7,. . . , 15 has been used in the above equation, the choice is flexible and the user selects those attributes that he or she considers most sensitive to measure similarity in a given type of data in lines 20-40 of column 13.

Re claim 16 which stands rejected on the rejected base claims, Alam further teaches the parallelepiped cube subvolume in the cube 22 subgroup in figure 8 and teaches a first pair of events in laterally orthogonal directions radiating from C. Pass the unique plane through said events and C. Extrapolate the plane to intersect all traces in said matrix cube 50 in line 60 of column 13.

With regard to claim 17, Alam discloses all the limitations for claim 17 and the Seismic data processing of real geophysical data distributed over a cube data image in figure 1 and teaches the steps for selecting the small subvolume as the "small subvolume of time-windowed traces with each trace containing multiple events, that is circumscribed around each event as center of a scalar mathematical functional, the Event Dissimilarity is derived to measure the dissimilarity by combining the temporal attribute differences between the center

event and each event on the laterally separated traces within the subvolume." See figure 1 and the disclosure in lines 35-44 of column 5. He further teaches processes to calculate from the trace and its Hilbert Transform the instantaneous envelope 42, e (t), and instantaneous phase, .phi.(t), and instantaneous frequency, .omega.(t). The troughs of the envelope function e (t) are used to define boundaries of the wave packet, identified by the index i, 43. The trough boundaries also coincide with locations where the instantaneous frequency has spikes and instantaneous phase has discontinuities. After detecting each wave packet boundary on a trace the process cuts the trace into contiguous wave packets, which begin at one and end at the next boundary. The index i, 43, varies over the plurality of wave packet segments that make up the signal trace, h (t), at grid location 31. The qualifying word `instantaneous` with references to the envelope, frequency, and phase functions will imply that they are instantaneous functions in lines 10-25 of column 9.

He further discloses and teaches, the limitations for transformation of the data by performing a Hilbert transformation in process calculates from the trace and its Hilbert Transform the instantaneous envelope 42, e (t), instantaneous phase, .phi.(t), and instantaneous frequency, .omega.(t)., in line 10 of column 9. "The event with the least Event Dissimilarity on a trace is called the `most similar event" for that trace. He teaches a smooth approximating surface, and the local wave front, is estimated such that it passes exactly through the time at the center event and best fits the times of most similar events on laterally separated traces. The time misfit error statistics, for example, the mean and variance of

time residuals between the actual event time and local wave front time at each trace in the said sub volume is calculated. A `local attribute surface` is estimated for each attribute in a manner similar to the estimation of local wave front. Each local attribute surface passes exactly through the value of that attribute at the center event and best fits the value of the same attribute at each event whose time is in closest proximity to the local wave front. A misfit error is then calculated for each attribute. Parameters of the local wave front, time misfit error, each local attribute surface and corresponding attribute misfit error are collectively called spatial attributes." Of the target set from the seismic geophysical data batch as found in figure 1 and in lines 35-65 of column 5.

He further discloses the Transformation of real geophysical data in the N-dimensional volume with the superset of N attributes, i.e. [the known features of interest], and the combining of both the temporal and spatial attributes, that characterizes the volume of waveform in the neighborhood of the center event. The procedure maps a 3-dimensional event at (x, y, t) into an N-dimensional attribute space" with its Hilbert Transform, as found in lines 60-65 in column 5.

He further teaches selecting a subvolume in the "attribute gradient is the spatial gradient of the surface that passes through an attribute at center event and best fits the same attribute of events that are in close proximity of the local wave front on laterally separated traces within a small sub volume of the total volume enclosing the center event in lines 60-66 of column 7.

Alam further discloses the plurality of positions is associated with the plurality of points into the N-dimensional point in the attribute space in the

volume in lines 9 and teaches "normalized attribute gradient vector is a normalized set of attribute gradients corresponding to a specified set of attributes and teaches a superset comprising the union of normalized temporal and spatial attributes, and normalized time gradient to local wave front, using equations [A.sub.I, . . . , A.sub.N], and further teaches that the subset is associated with the event, (x, y, t), so that a 3-dimensional point or position in the seismic volume is mapped into an N-dimensional point in the attribute space as found in lines 1-15 of column 8 and further teaches the modeling steps using 10 principal steps. First, model a seismic volume as a collection of events in a 3-dimensional (x, y, t) space, called domain D. In the case of a regularly sampled 3-D data, these events are indexed equally in the x- and y-directions, although the space interval between indices may be different for each direction. Event sampling in the time t-direction is generally sparse and unequally spaced. Second, associate with each event a number, N, of attributes, denoted by the vector A. Third, normalize each attribute in the [0,1] interval. This process maps said 3-dimensional domain to an N-dimensional L1-normed attribute range. The absolute value attribute norm, L1, is used for computational efficiency, but does not limit the application of the method, which is valid for any norm. Fourth, if depth instead of time is used to analyze the spatial continuity of an event, said (x, y, t) the space is scaled by an appropriate velocity to represent the actual distances in the three directions. This space is L2-normalized and labeled as a new (x, y, z) coordinate system with Euclidean norm. The continuity of an event is then quantitatively analyzed in terms of Frechet derivatives, taught by D. G.

Luenberger, p. 172-5 in lines 15-35 in combinations with figure 1. He further teaches the fifth interactively threshold and combine any subset of attributes via a spatial, arithmetic, logical or morphological operation into an indicator functional, which is again normalized to [0,1] interval. Sixth, map the normalized interval to a user selected color spectrum on a graphical workstation. Seventh, render events as points in the 3-D survey volume, and assign to each point the color that represents the indicator functional value of the event, as for example the average of normalized amplitude and normalized peak-to-trough amplitude difference. The three dimensional display shows geological structures as loci of events, and stratigraphic compartments as patterns of colors. Eighth, remove unwanted regions in the volume by the use of a histogram filter. Ninth, select a thin slab whose face is parallel to one of the three principal planes and integrate the indicator functional over the thickness of the slab. Animate the slab in a direction perpendicular to the face of the slab with target anomalies moving into and then out of the viewing range. Apply a similar animation process to the rotation of either the entire volume or a small sub volume, wherein the integration is performed along arcs in a small angular wedge through the axis of rotation. Tenth, locate with a graphical cursor any isolated anomaly and output the result as a hardcopy plot or archival file in lines 35-60 of column 8.

Re claim 18, which stands rejected on the rejected base claim, the steps for performing the limitation of modifying the subvolume in which any "subset of individually normalized attributes is then selected and combined on a graphical workstation into a functional, called indicator functional, with its range of values

mapped in a color spectrum. The resulting 3-D display automatically shows geological structures as locus of point sets and the stratigraphic compartments as color variations within the point and position sets within the volume. The same color in spatially separated anomalies indicates that the anomalies share common features characterized by the threshold range and the mix of individual attributes in the indicator functional. Further, on a workstation equipped with sound, two or more subsets of N attributes instead of one are combined into indicator functional with functional values of one displayed in color and those of others played as sounds of varying audio-frequency tone and volume." as disclosed in lines 1-15 of column 6.

Re claims 19 which stand rejected on the rejected base claim, the steps for performing the limitation of normalizing the transformed data is taught in figure 1 and in the "Subsets of multiple attributes are interactively selected, threshold and combined with one out of a suite of mathematical operators into a scalar function which is mapped onto a user selected color spectrum. Three dimensional features, where geological structure and stratigraphic compartments, including those that cannot be detected with conventional techniques, automatically emerge in the 3-D volume as the composition of attributes in the subset, threshold limits of attributes or the mathematical form of operator is interactively varied" as disclosed in the abstract and in lines 20-25 of column 10.

Re claims 20 which stand rejected on the rejected base claims, the limitation further comprising the image set is the target set is disclosed in figure 1 with computer processes of the cube model.

With regard to claim 21, Alam discloses all the limitations for claim 21 and the Seismic data processing workstation in figure 1. He further discloses the steps for a computer system in the computer implemented workstation in figure 10 and discloses the computer aided method in line 20 of column 5 and discloses elements of the workstation computer in lines 55-65 of column 6 and in figure 1 and teaches seismic data model processes in lines 35-44 column 5.

He further discloses and teaches the limitation of receiving seismic data from the input device in figure 1 and teaches receiving "the target image data set from the seismic geophysical data batch as found in figure 1 and in lines 35-65 of column 5.

He further discloses receiving the superset of N attributes, i.e. [the known features of interest], and the combining of both the temporal and spatial attributes, that characterizes the volume of waveform in the neighborhood of the center event. The procedure maps a 3-dimensional event at (x, y, t) into an N-dimensional attribute space", as found in lines 60-65 in column 5.

Alam further discloses receiving the plurality of positions in figure 1 associated with the plurality of points into the N-dimensional point in the attribute space in the volume in lines 60-65 of column 5. He further teaches the "attribute gradient" is "the spatial gradient of the surface that passes through an attribute at center event and best fits the same attribute of events that are in close

proximity of the local wave front on laterally separated traces within a small subvolume of the total volume enclosing the center event in lines 60-66 of column 7 and He further discloses the "normalized attribute gradient vector is a normalized set of attribute gradients corresponding to a specified set of attributes and teaches a superset comprising the union of normalized temporal and spatial attributes, and normalized time gradient to local wave front, using equations [A.sub.I, . . . , A.sub.N], and further teaches that the subset is associated with the event, (x, y, t), so that a 3-dimensional point or position in the seismic volume is mapped into an N-dimensional point in the attribute space as found in lines 1-15 of column 8.

He further teaches calculating with the workstation processor in figure 1 the model by using 10 principal steps. First, model a seismic volume as a collection of events in a 3-dimensional (x, y, t) space, called domain D. In the case of a regularly sampled 3-D data, these events are indexed equally in the x- and y-directions, although the space interval between indices may be different for each direction. Event sampling in the time t-direction is generally sparse and unequally spaced. Second, associate with each event a number, N, of attributes, denoted by the vector A. Third, normalize each attribute in the [0,1] interval. This process maps said 3-dimensional domain to an N-dimensional L1-normed attribute range. The absolute value attribute norm, L1, is used for computational efficiency, but does not limit the application of the method, which is valid for any norm. Fourth, if depth instead of time is used to analyze the spatial continuity of an event, said (x, y, t) space is scaled by an appropriate

velocity to represent actual distances in the three directions. This space is L2-normalized and labeled as a new (x, y, z) coordinate system with Euclidean norm. The continuity of an event is then quantitatively analyzed in terms of Frechet derivatives, taught by D. G. Luenberger, p. 172-5. In lines 15-35 in combinations with figure 1. He further teaches the fifth interactively threshold and combine any subset of attributes via a spatial, arithmetic, logical or morphological operation into an indicator functional, which is again normalized to [0,1] interval. Sixth, map the normalized interval to a user selected color spectrum on a graphical workstation. Seventh, render events as points in the 3-D survey volume, and assign to each point the color that represents the indicator functional value of the event, as for example the average of normalized amplitude and normalized peak-to-trough amplitude difference. The three dimensional display shows geological structures as loci of events, and stratigraphic compartments as patterns of colors. Eighth, remove unwanted regions in the volume by the use of a histogram filter. Ninth, select a thin slab whose face is parallel to one of the three principal planes and integrate the indicator functional over the thickness of the slab. Animate the slab in a direction perpendicular to the face of the slab with target anomalies moving into and then out of the viewing range. Apply a similar animation process to the rotation of either the entire volume or a small sub volume, wherein the integration is performed along arcs in a small angular wedge through the axis of rotation. Tenth, locate with a graphical cursor any isolated anomaly and output the result as a hardcopy plot or archival file in lines 35-60 of column 8.

Re claim 22, which stands rejected on the rejected base claim, the steps for storage in the graphical work station is taught in figure 1 and further discloses steps in which any "subset of individually normalized attributes is then selected and combined on a graphical workstation into a functional, called indicator functional, with its range of values mapped in a color spectrum. The resulting 3-D display automatically shows geological structures as locus of point sets and the stratigraphic compartments as color variations within the point and position sets within the volume. The same color in spatially separated anomalies indicates that the anomalies share common features characterized by the threshold range and the mix of individual attributes in the indicator functional. Further, on a workstation equipped with sound, two or more subsets of N attributes instead of one are combined into indicator functional with functional values of one displayed in color and those of others played as sounds of varying audio-frequency tone and volume." as disclosed in lines 1-15 of column 6.

Re claims 23- 26 which stand rejected on the rejected base claim, the limitations for computer readable program and instructions for receiving and instructions for calculating with computer processes is disclosed in figure 1 with steps for calculating the N-dimensional volume using the work station in figure 10 and the subcube modeling computation processes in lines 20-65 of column 5.

Conclusion

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Victor J. Taylor whose telephone number is 571-272-2281. The examiner can normally be reached on 8:00 to 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, John E. Barlow can be reached on 571-272-2863. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

V. J. Taylor
12 May 2005.

John Barlow
Supervisory Patent Examiner
Technology Center 2800